Distribution of platypus *Ornithorhynchus anatinus* in the Richmond River Catchment, northern New South Wales

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ABSTRACT

The current and historical distribution of the platypus *Ornithorhynchus anatinus* was studied in the Richmond River catchment, northern New South Wales. In order to determine whether changes in distribution have occurred over the past 60–70 years, sightings were collected from residents, government departments and by reviewing existing records. A range of methods was used to collect platypus sightings from residents, including a media campaign, questionnaires and a resident survey, where people in more remote areas of the catchment were approached and asked if they had sighted platypuses. The public provided information on 300 sites. Eighty-two per cent of these were occupied by platypuses, 11% were previously but no longer occupied by platypuses, and 6% were sites where platypuses have never been recorded. Public sightings indicate that platypuses are widely distributed throughout the catchment, and that they are more commonly sighted in areas of basalt than sandstone substrates. The distribution of platypuses appears to have contracted in some parts of the catchment.

INTRODUCTION

The platypus *Ornithorhynchus anatinus* is one of only three extant species in the order Monotremata and the only species in the family Ornithorhynchidae. The Monotremata is the sister group to the entire Theria, which includes all other mammals. The unique phylogenetic position of the platypus makes it extremely significant from a biodiversity conservation perspective (Crozier 1992; Baverstock *et al.* 1994). Thus detailed information on its local distribution and abundance should be collected throughout its geographic range.

The conservation status of the platypus has been investigated at both a state and national level (Grant 1991; Grant 1992a). Grant (1992a) suggested that the platypus is currently widespread and common in Tasmania, Victoria, New South Wales and Queensland, but is possibly extinct in South Australia. Grant (1991, 1992a) suggested that the overall distribution of the platypus has changed little since European settlement, although its distribution may have contracted in some parts of its historical range. The broad scale of the surveys by Grant (1991, 1992a) make it difficult to identify small scale or regional changes in platypus distribution, primarily because the survey data are spread over a large area. Detailed regional surveys where the survey effort is concentrated in a smaller area are needed to provide a better indication of platypus distribution (Grant 1998; Linterman 1998; Lunney *et al.* 1998).

Although not listed under the New South Wales *Threatened Species Conservation Act 1995*, both Carrick (1995) and Grant (1991) record the status of the platypus as common but vulnerable. These authors consider that the platypus should be regarded as vulnerable because of its dependence on waterbodies threatened by a large number of impacts. Impacts on platypus and their habitat include illegal and legal fish netting, water pollution, sand and gravel extraction, and dam construction (Grant 1991, 1993). Fish netting, dam construction, and water extraction have been the focus of detailed study (Grant 1981a,b; Grant 1993; Goldney 1995a), while dam operation and catchment management have received limited attention.

In view of the wide range of factors affecting platypuses, and our limited knowledge of likely impacts, it is possible that platypus distribution has contracted in areas where it is currently considered common. To ensure effective management of the platypus and its habitat it is essential that small scale changes in distribution are identified.

In the present study we focused on the Richmond River Catchment. Our aims were to compare the current and historical distribution of platypuses and to identify possible factors influencing changes in platypus distribution.

METHODS

Study area

The Richmond River Catchment is situated in the northeastern corner of New South Wales (Fig. 1) and covers an area of 6 940 km^2. It is dissected by the Richmond and Wilson Rivers. The soils can be divided into two

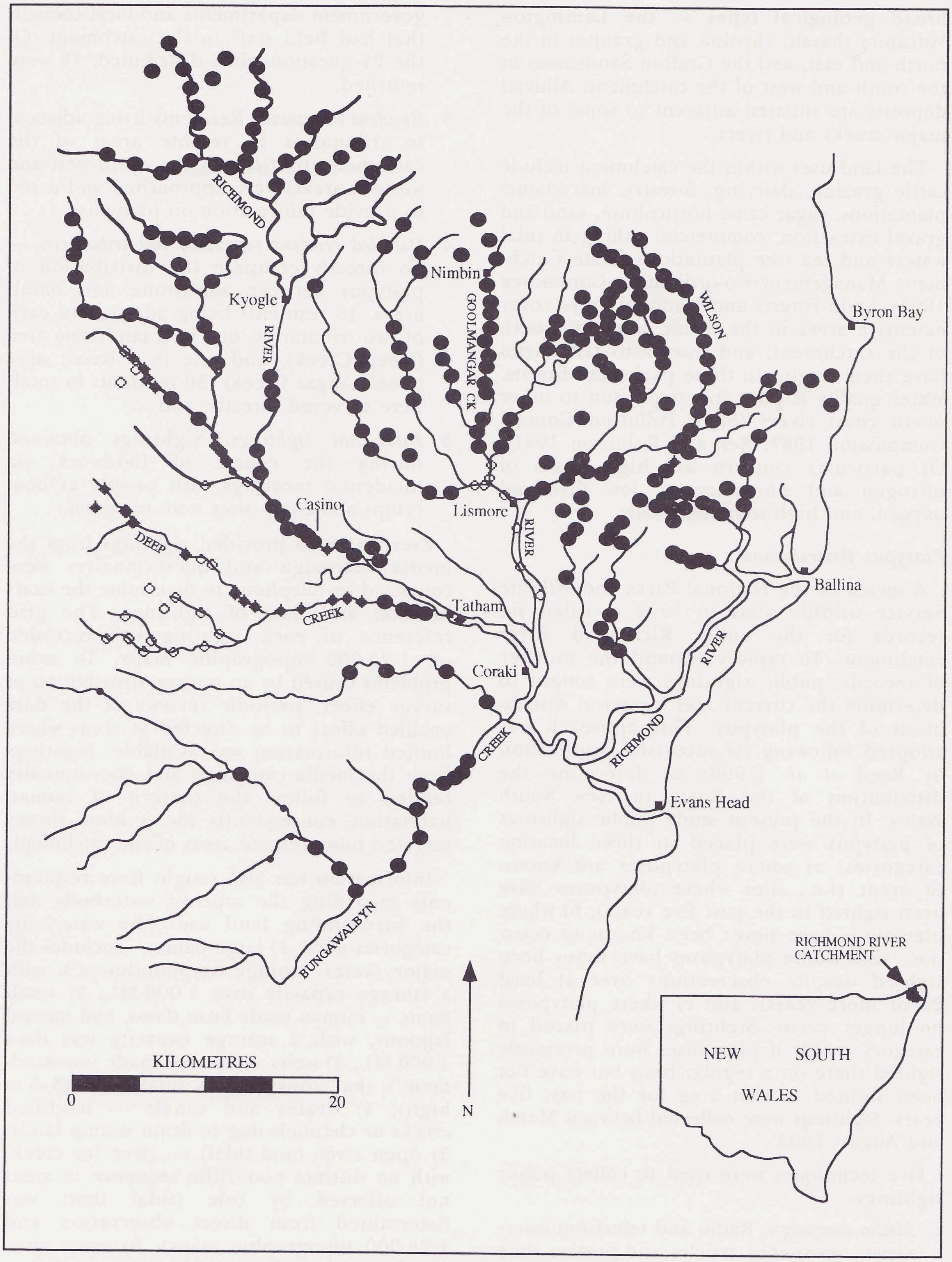

Figure 1. Distribution of platypus sightings in the Richmond River Catchment from a media campaign, surveys of residents, and a tributary census. The distribution map includes platypus sightings ●, possible sightings (sightings where the respondent was unsure if it was a platypus or not) •, non-sightings (sites where platypus have never been seen) ◇, and historical sightings (sites where platypus previously but no longer occur) ◆.

broad geological types — the Lamington Volcanics (basalt, rhyolite and granite) in the north and east, and the Grafton Sandstones in the south and west of the catchment. Alluvial deposits are situated adjacent to some of the major creeks and rivers.

The land uses within the catchment include cattle grazing, dairying, forestry, macadamia plantations, sugar cane, horticulture, sand and gravel extraction, commercial fishing in tidal waters and tea tree plantations (State Catchment Management Co-ordinating Committee 1991). State Forests and National Parks cover extensive areas in the north, west and south of the catchment, and numerous tributaries have their origins in these parks and forests. Water quality is poor in comparison to other north coast rivers (State Pollution Control Commission 1987; Bek and Robinson 1991). Of particular concern are high levels of nitrogen and phosphorous, low dissolved oxygen, and high sediment loads.

Platypus Distribution

A review of the National Parks and Wildlife Service wildlife atlas in 1992 revealed six records for the entire Richmond River catchment. To rapidly expand the number of records, public sightings were sought to determine the current and historical distribution of the platypus. This approach was adopted following its successful application by Reed *et al.* (1990) to determine the distribution of the Koala in New South Wales. In the present study public sightings of platypus were placed in three location categories: a) where platypuses are known to occur (i.e., sites where platypuses have been sighted in the past five years); b) where platypuses have never been known to occur (i.e., sites where platypuses have never been sighted despite observations over at least 20 or more years); and c) where platypuses no longer occur. Sightings were placed in category c only if platypuses were previously sighted there on a regular basis but have not been sighted in that area for the past five years. Sightings were collected between March and August 1992.

Five techniques were used to collect public sightings:

1. *Media campaign*. Radio and television interviews, newspaper articles and posters were used to arouse public awareness of the need for sightings. Residents with information were asked to call a central number and leave details of their sightings, as well as their name and contact number;
2. *Questionnaire*. Questionnaires asking for information on platypus were sent to government departments and local councils that had field staff in the catchment. Of the 25 questionnaires distributed, 18 were returned;
3. *Resident interviews*. Residents living adjacent to tributaries in remote areas of the catchment (particularly the north-west and western areas) were approached and asked to provide information on platypus;
4. *Detailed resident census of two tributaries* — To directly compare the distribution of platypus between sandstone and basalt areas, 15 residents living adjacent to each of two tributaries, one in a sandstone area (Deep Creek), and one in a basalt area (Goolmangar Creek) (30 residents in total) were surveyed directly; and
5. *Incidental sightings*. Sightings obtained during the course of fieldwork via incidental meetings with people at boat ramps and camp sites were recorded.

Everyone who provided sightings from the media campaign and questionnaires were contacted by telephone to determine the exact location and date of sightings. The grid reference of each sighting was recorded on 1:25 000 topographic maps. To avoid problems caused by an uneven distribution of survey effort, periodic reviews of the data enabled effort to be directed at areas where limited information was available. Sightings from the media campaign and questionnaire tended to follow the pattern of human habitation, consequently the resident survey targeted more remote areas of the catchment.

Information was also sought from respondents regarding the type of waterbody and the surrounding land use. The waterbody categories were: 1) large dams — includes the major water storage impoundment's with a storage capacity over 1 000 ML; 2) small dams — human made farm dams, and natural lagoons, with a storage capacity less than 1 000 ML; 3) weirs — human made impoundment's that consist of a small wall (3–5 m high); 4) drains and canals — modified creeks or channels dug to drain swamp lands; 5) open river (non-tidal) — river (or creek) with no distinct pool/riffle sequence in areas not affected by tide (tidal limit was determined from direct observation and 1:25 000 topographic maps); 6) open river (tidal) — river (or creek) with no distinct pool/riffle sequence that was influenced by tide; and 7) closed river (pool/riffle) — creek (or river) with a distinct pool/riffle sequence.

Information on adjacent land use was collected from respondents, through direct observation, and from 1:25 000 air photos.

Land-use categories were: 1) agricultural — includes beef, dairy and any type of plantation (included in this category were small rural communities that consisted of a few houses); 2) urban — larger towns that consisted of a main street, with street lights etc; 3) State Forest — area designated as a State Forest; 4) National Park — areas gazetted as National Park; 5) Nature Reserve — areas gazetted as a Nature Reserve.

Sighting Verification

Because residents may confuse the platypus with the Australian Water Rat *Hydromys chrysogaster* or the Eastern Water Dragon *Physignathus lesueurii* it was decided to validate public sightings by visiting sites to determine the presence or absence of platypuses. A programme was initiated that aimed to determine the time and number of visits required to visually confirm the presence of platypuses. The sighting programme was developed because there were no published accounts of observational studies at the time of the survey.

Twenty-five sites known to be occupied by platypuses (e.g., sites where platypuses are regularly seen) were visited on consecutive mornings and afternoons until a platypus was observed. Observations were made by sitting silently and motionless on the creek bank or from a canoe. One visit was a single morning or evening observation period. The time taken to observe platypuses was recorded at each site.

RESULTS

Sighting programme

The sighting programme indicates a 68% chance of observing platypus on the first visit, and a 92% chance of observing platypus after three visits (Table 1). Twice as many sightings were made during morning compared with afternoon observations. More (35%) sightings occurred in the 30 minute period immediately after first light than any other period. The results suggest that at least 180 minutes of observation over three mornings are required to determine if platypuses are present. This method was used to verify the accuracy of records provided by the public.

Table 1. The number of visits required to confirm the presence of platypus at 25 sites sampled during the sighting programme. The success of each visit is expressed as a cumulative percentage of the total number of visits. The success of morning and evening observations are expressed as a percentage.

	Visit Number			
	One	Two	Three	Three +
No. Sites (n = 25)	17	3	3	2
Cum. % of Total	68%	80%	92%	100%
% of obs — morning	71	70	65	65
afternoon	29	30	35	35

Verification of public records showed that at least 96% of records were accurate. Of the 21 sites identified by the public to be occupied by platypuses, positive sightings were made at 20 sites, and no platypuses were sighted at any of the four reported non-sightings after three consecutive visits. Each visit was 60 minutes in duration.

Platypus distribution

The public provided information on 300 sites (Table 2). Of these, 82% (245 sites) recorded platypus as present (P), 11% (34) were of sites previously but no longer occupied by platypus (NLP) and 7% (21) were from areas where platypus have never been sighted (NP). The media campaign provided information on 156 sites (52% of total), with 95% of these occupied by platypus. Questionnaires provided no NLP (0%) and very few NP (2%) sightings. However, of the 64 sightings collected during the resident census, 20% were NLP and 25% were NP, while 42% of sites identified by the tributary census were NLP (Table 2).

Most records of platypus (85%) were made between 1988 and 1992, while the remaining 15% were made prior to 1988. Some historical sightings (NLPs) dated back to the early 1940s, although most were between 1960 and 1985.

Ninety-three per cent of platypus records were from tributaries in the northern half

Table 2. Total number of sightings collected for each method employed during the study. No. respondents = number of people that responded to the request for records, P = sites with platypus, NLP = sites previously but no longer occupied by platypus, NP = number of sites where platypus were never sighted.

		Percentage of individual sites			
Method	No. Respondents	P	NLP	NP	n
Media Campaign	91	61%	12%	14%	156
Questionnaires	18	16%	0	5%	40
Resident Census	42	14%	38%	76%	64
Tributary Census	30	9%	50%	5%	40
Total	179	245	34	21	300

of the catchment, in the system of weirs surrounding the township of Casino, and above the tidal limit in Bungawalbin Creek (Fig. 1). Very few NP or NLP sightings were collected from these areas. Despite an intensive survey effort few records of platypus were collected from tributaries in the mid-west of the catchment, and 70% of sites abandoned by platypus were situated in the mid-western and southern parts of the catchment.

No records of platypus were collected for the Wilson River downstream of Lismore, in the Richmond River downstream of Tatham or in a small number of tributaries in the mid-western region of the catchment (Fig. 1). Tributaries sampled in the detailed resident census revealed distinct differences between the basalt (Goolmangar Creek) and sandstone (Deep Creek) areas. Twenty-six records of platypus were collected from the systematic survey of Goolmangar Creek, with only three records of platypus and 15 NLP records collected from Deep Creek (Fig. 1).

Seventy-two per cent of sites occupied by platypus were from areas with a distinct pool riffle sequence (closed river), with 12% from open river sites of which only 3% (5 sites) were from tidal affected areas (Table 3). NPs were spread evenly between pool/riffle areas (43%) and open rivers (38%), with 33% of open river sites situated in tidal areas. The distribution of sightings in different land-use categories showed that the majority of sightings (74%) were from agricultural areas, although 100% of NLP and 90% of NP were also from agricultural regions (Table 3).

Table 3. Percentage of sightings from different types of water bodies and from water bodies in different land use categories. Tot P = percentage of the total number of sites with platypus, Tot NLP = percentage of the total number of sites no longer occupied by platypus, Tot NP = percentage of the total number of sites where platypus never sighted. The number of sites is shown in brackets.

	% of Tot P	% of Tot NLP	% of Tot NP
Stream (site) Characteristics			
Large Dams	2 (4)	—	19 (4)
Small Dams	7 (17)	9 (3)	—
Weirs	6 (16)	6 (2)	—
Drains and canals	1 (3)	—	—
Open River — non-tidal	9 (22)	11 (4)	5 (1)
Open River — tidal	3 (8)	18 (6)	33 (7)
Closed River — pool/riffle	72 (175)	56 (19)	43 (9)
Adjacent land use			
Agriculture	74 (181)	100 (34)	90 (19)
Urban	10 (26)	—	—
State Forest	10 (25)	—	10 (2)
National Pk.	2 (5)	—	—
Nature Res.	4 (4)	—	—

DISCUSSION

Evaluation of the methodology

Gill and fyke netting are the most common methods used to determine the presence of platypus and research on alternative methods of platypus detection are limited (Grant 1995). Observation is a possible alternative to trapping. Visual observation is less time consuming, which means that more sites may be visited in a shorter period of time. Netting is also subject to variability, and can be influenced by flow rates and weather conditions (Grant 1992b; Goldney 1995b). The success of netting for platypus in northern New South Wales rivers is also affected by large schools of fish that get tangled in nets, reducing their effectiveness and increasing the chance of drowning platypus.

Despite the benefits of the technique visual observation has largely been ignored, although some studies have used a combination of trapping and visual observation (Grant 1981a; Goldney 1995b). Factors that affect the quality of visual observations include the presence of transient individuals within a population, the difficulty associated with observing platypus, and the variable density of platypus within a specific area (Grant 1992b, 1995). The mobile nature of platypus (particularly males) also means that the spatial distribution of observation points is critical (Serena 1994; Gardner and Serena 1995). Despite the above limitations, visual observation is regarded by us as a useful method of determining presence/absence, and should be used to complement data collected from trapping.

During the present study we developed a basic method to determine if platypus were present at a particular site with the aim of assessing the validity of public sightings. Critical review of this method reveals some deficiencies. The results of the sighting programme may have been elevated due to increased activity of platypus associated with juvenile dispersal at the time of the survey (Grant 1995). In addition, the failure to locate platypus at a specific site may indicate reduced platypus density rather than the absence of platypus.

Public sightings have been used in a number of large scale surveys to determine platypus distribution (Grant 1991, 1992a; Lunney *et al.* 1998; Turnbull 1998), and Grant (1981a) found public sightings to be reliable as verified by trapping. Recent studies have also highlighted the value of using local residents to assess the distribution of koalas *Phascolarctos cinereus* (Reed *et al.* 1990; Lunney

et al. 1997). Field verification conducted during the present study indicates that public sightings were reliable and can therefore provide an accurate indication of platypus distribution.

One problem associated with using public sightings to assess the distribution of platypus is that the resulting distribution map is largely determined by human activity patterns, human population size and distribution of survey effort (Lunney *et al.* 1997). During the present study, platypus sightings collected from the media campaign tended to reflect the pattern of human habitation and movement within the catchment. However, questionnaires and particularly the resident surveys enabled sightings to be collected from less inhabited areas of the catchment, thereby providing a more complete indication of platypus distribution and most importantly providing a number of records for sites previously but no longer inhabited by platypus.

The results suggest that respondents to the media campaign were, as might be expected, less likely to provide non-sightings than sightings. Historical records, and locations where platypus have never been sighted, were more effectively collected by surveying residents in person. This result may be attributed to the fact that people were less likely to take notice of and respond to media articles if they had not seen platypus. Very few non-sightings or historical sightings were collected from questionnaires, which may be because the questionnaire survey was limited to government departments. Lunney *et al.* (1997) received very few sightings from government departments compared with local residents. The varied results among the different survey methods show that it is necessary to use a variety of techniques to determine platypus distribution, and surveys based on one method alone may not provide an accurate indication of distribution.

Grant (1991) collected public sightings for two categories: 1) sites where platypus have been seen; and 2) sites where platypuses have never been seen. Public sightings of areas where platypuses have been seen appear to be reliable. However, non-sightings may simply reflect lower densities of platypus. During the present study, a third sighting category was used to collect information on areas where platypuses no longer occur (historical sightings). It was hoped that sightings from this category would provide information on possible factors affecting platypus distribution. Unfortunately these sightings may reflect a change in the behaviour of the observer over time, or a reduction in the density of platypuses rather than the absence of platypuses. As a consequence, conclusions based on historical sightings are made with caution.

Historical distribution

The historical distribution of platypus was determined by combining sites where platypuses were previously but are no longer sighted with sites where platypuses are regularly sighted, in a manner similar to that used by Reed *et al.* (1990) for koalas. By combining these two sighting categories we suggest that historically, platypuses were widely distributed throughout the Richmond River catchment, but were less common in sandstone than basalt regions.

By studying the distribution of a species we can obtain information on its habitat requirements and identify possible factors limiting its distribution. Grant (1991) summarized platypus habitat requirements as:

an adequate supply of benthic invertebrates for food;

consolidated stream banks for burrow construction;

and water depth less than five metres.

In addition, Bryant (1993) identified pool length and the presence of overhanging vegetation as important habitat requirements. The historical distribution of platypuses in the Richmond catchment lends support to the findings of both Grant (1991) and Bryant (1993).

The upstream limit of platypus distribution is difficult to determine because most creeks have their headwaters in State Forests and National Parks, in areas not regularly visited by people. However, platypus distribution in the Richmond Catchment may be similar to the Bombala Catchment where Turnbull (1998) found that they were absent from the upper 15 km of most creeks and rivers. Goldney (1995b) also noted that platypuses were less common in the upper reaches of the Thredbo River. The absence of platypuses from upstream sites in the Richmond catchment can be attributed to a range of factors including seasonal stream flow, pool size and the presence of rocky creek banks. Seasonal stream flow and unconsolidated stream banks may also explain the historical absence of platypus from a small number of creeks in the south west of the catchment (Fig. 1).

The downstream distribution of platypus appears to be limited by water depth and tidal influence. No platypus sightings were received for the Wilson River below Lismore, or for the Richmond River below Tatham. Water depth

in these areas is generally greater than five metres (Rohweder 1992), and the tidal surge is often up to half a metre even though the water is fresh. The influence of water depth and tidal range on platypus is undetermined although it is suggested that platypus may not be able to forage efficiently in water with an average depth greater than five metres, while the rise and fall of the tide may make it difficult to access burrows in areas where the banks are steep. Kruuk (1993) found that water depth had a "small but significant" effect on time spent under water, although he did not show if depth influenced feeding efficiency. Commercial fishing is conducted in the tidal waters of both the Richmond and Wilson Rivers although no evidence was gathered to suggest that this activity may be limiting platypus distribution.

Current distribution

The current distribution of the platypus indicates that they have suffered some decline in sandstone areas of the catchment where they were historically uncommon but widespread. This statement is based on the fact that over 90% of the 34 sites previously but no longer occupied by platypuses are situated in sandstone creeks in the west of the catchment. Although the failure to record platypus at these sites may be attributed to reduced density or changes in observer behaviour over time, the large number of abandoned sites over an extensive area of creek suggests that some declines have occurred.

Localized declines in platypus distribution have also been recorded by Grant (1993) in western New South Wales, Lunney *et al.* (1998) in the Eden region of New South Wales, Lintermans (1998) in the Australian Capital Territory, and Grant (1998) for the Sydney region of New South Wales. The apparent decline in platypus distribution can largely be explained by studying those factors that affect their basic habitat requirements. Although platypus appear to tolerate some changes in the quality of habitat, and show a high tolerance to habitat modification (e.g., the use of farm dams), a number of factors have been identified that may influence their distribution (Grant 1991, 1993).

Information collected during the present study suggests that stream bank erosion and sediment deposition may be the primary factors affecting platypus distribution, particularly in sandstone areas. All of the creeks where platypuses have apparently disappeared have been degraded by the removal of riparian vegetation, and subsequent stream bank erosion and sediment deposition. Creeks that were historically characterized by a rocky substratum and deep pools are now characterized by shallow water (i.e., about 2–10 cm) and a sandy substratum. The increased height of the substratum of these creeks means that during dry periods surface flow may stop, even though water may continue to flow under the sediment. Such a dramatic change in the flow regime has considerable implications for platypus as it reduces the amount of habitat available for foraging. Although riparian vegetation has been removed from creeks in basalt regions the impact on platypuses has been less significant, possibly because of the consolidated nature of basalt soils.

The change in the structure of some sandstone creeks is largely attributed to land management practices associated with agriculture. The high number of abandoned sites recorded from agricultural areas (Table 3) tends to support this suggestion. In this study 74% of platypus sightings were from agricultural areas. Similar results were achieved by Lunney *et al.* (1998) who found that 77% of platypus sightings were from rural areas in the Eden region. While this may simply reflect the area of the catchment that is set aside for agriculture it also can imply that platypus show a preference for agricultural areas.

The results of the present study provide further evidence of the apparent tolerance of platypus to some human induced changes in habitat quality. Their presence in weirs and small dams indicates that they occupy both human made impoundments and altered creek habitats. The absence of platypus from two of the three large water storages within the catchment lends support to the suggestion by Grant (1981a,b, 1991) that dam construction and operation can have a detrimental effect on platypus distribution.

The results of the present study suggest that the distribution of platypus in the Richmond Catchment has been affected by land management. Further "catchment wide" studies are required to determine the extent of changes in platypus distribution, and to assess the implications of these changes to the conservation of platypus.

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